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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification: C04B 41/81, B41M 1/34	A1	(11) International Publication Number: WO 00/63136 (43) International Publication Date: 26 October 2000 (26.10.00)
(21) International Application Number: PCT/EP00/03483 (22) International Filing Date: 18 April 2000 (18.04.00) (30) Priority Data: FO99A000009 19 April 1999 (19.04.99) IT (71) Applicant (for all designated States except US): CERTRONIC S.R.L. [IT/IT]; Via Cervese, 221/A, I-47100 Forlì (IT). (72) Inventor; and (75) Inventor/Applicant (for US only): PRIMAIO, Fabio [IT/IT]; Via Cervese, 221/A, I-47100 Forlì (IT). (74) Agent: GERVASI, Gemma; Notarbartolo & Gervasi S.p.A., Corso di Porta Vittoria, 9, I-20122 Milan (IT).		(81) Designated States: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
(54) Title: METHOD FOR DECORATING A CERAMIC UNFIRED SUPPORT AND APPARATUS FOR CARRYING OUT SAID METHOD (57) Abstract The present invention refers to a method for decoration with one or more colours on a ceramic unfired support (4) made of stoneware, porcelainized stoneware or other equivalent material, in which the decoration is achieved by applying on the support (4), by means of bubble jet or ink jet devices (2) of a commercial type controlled by a logic unit (5), colouring materials having a high capacity for penetrating the material of which the support (4) is composed. An apparatus for carrying out this method is also described.		

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METHOD FOR DECORATING A CERAMIC UNFIRED SUPPORT AND APPARATUS FOR CARRYING OUT SAID METHOD

Field of the invention

The present invention refers to a method for decorating with one or more colours on a ceramic unfired support and to an apparatus for carrying out said method.

Summary of the invention

A method is described for decoration with one or more colours on a ceramic unfired support 4 made of stoneware, porcelainised stoneware or other equivalent material, in which the decoration is achieved by applying on the support 4, by means of bubble jet or ink jet devices 2 of a commercial type controlled by a logic unit 5, colouring materials having a high capacity for penetrating the material of which the support 4 is composed.

The colouring materials are soluble pigments specifically intended for the material used to realise the support 4, these pigments are preferably soluble in water-alcohol mediums, water, glycol, and solutions that do not conduct electricity; they include complexed salts or metal chromophore ions with polycarboxyl organic acids or organic or inorganic derivatives and they are fired at a temperature of over 1000°C after they have been applied on the ceramic unfired support 4.

The logic unit 5 controls the bubble or ink jet devices 2 in reply to configurations stored in at least one memory associated with the logic unit 5 or generated at the time of printing by the logic unit itself.

An apparatus for carrying out this method is also described.

Brief description of the drawing

The invention will be now disclosed with reference to a preferred but not exclusive embodiment shown in the enclosed drawing sheet, where a top view and a side view of an apparatus according to the invention are shown, the side view further including a press 11 and a kiln 12.

Detailed description of the invention

The present decoration, after pressing, of unfired surfaces made of stoneware, porcelainised stoneware, single fired ceramics, ceramic mixers and similar products, is achieved by means of flat or rotating pads or frames for silk-screen printing, with

particular penetrating liquid pigments, suitably thickened (generally) with carboxymethyl cellulose and its derivatives, in order to allow their use with the mentioned above apparatus.

These liquid pigments are generally solutions in water-alcohol mediums, water, glycol or other mediums, including complexed salts or metal chromophore ions with polycarboxyl organic acids, and they may be buffered with ammonium salts, or organic or inorganic derivatives such as those listed below as an example: chlorides, nitrates, sulphates, citrates, lactates, gluconates, EDTA, tartrates, polyacrylates and others, supplied by specialised firms, and possibly legally protected by third parties.

The soluble pigments allow the colouring of unfired surfaces, penetrating to a depth of some millimetres within the surface itself, so as to obtain a finished product (fired at temperatures higher than 1000°C) with long-lasting decoration, present not only on the surface but also inside the support to a depth which depends on the quantity of product applied and on the application process: this also makes it possible to carry out subsequent processing of the decorated support, such as lapping or covering with enamel or glass.

To increase the penetrating capacity of the soluble pigment, on leaving the pressing phase the surfaces of the supports may be wet with water or with aqueous solutions of impregnating agents in a controlled manner, after and/or before application of the colours.

The present decoration techniques are characterised by low flexibility in making the decorations, which are restricted to the use of specific frames or pads for each pattern, and by a high mechanical stress to which the unfired ceramic material is subjected during the printing process.

This invention refers to a new method for decoration of unfired supports made of ceramic materials, which may or may not be covered with frit or enamel, by using colouring materials presenting a high capacity for penetrating the support (pigments soluble in water-alcohol mediums, water, glycol, and solvents that do not conduct electricity), where the decoration is achieved by applying them on the support by means of bubble jet or ink jet devices electronically controlled by a logic unit, in order to transform a picture, pattern or text, stored in analogical or digital

form, for example on a CD, hard disk, DAT, volatile memories, zip, magneto-optical support, floppy disk and other supports, or generated by a logic unit at the time of printing, into a decoration with one or more colours.

The bubble jet or ink jet devices are of a commercial type and are suitable for applying the above-mentioned colouring materials on the support.

The invention also refers to an apparatus for carrying out the above-mentioned method.

Since printing is carried out without contact, the fragile unfired surfaces are not subjected to any kind of mechanical stress, typical of silk-screen printing or of printing with flat or rotating pads.

Each bubble or ink jet device or group of bubble or ink jet devices may be placed at any direction or distance of printing, and at any angle of inclination with respect to the support, allowing the decoration of structured, depressed or at any rate non flat surfaces: this constitutes a considerable improvement in comparison with the techniques currently in use for decorating ceramic materials (such as silk-screen printing or pad printing) which allow decoration of exclusively flat surfaces.

Printing with a bubble or ink jet, in which the logic unit directly controls each of the bubble or ink jet devices, also allows very fast variation of the decorations to be produced, without changing frames or pads, adding and programming the type and quality of the patterns or pictures, as requested.

Thanks to the flexibility mentioned above, it is possible to insert random or rhythmic variations to one same type of pattern, repeated an infinite number of times or cyclically; for example it is possible to produce imitation marble by printing groups of several pieces with patterns that present only slight variations and which are produced cyclically, so as to imitate the shading of the natural product.

Depending on the particular type of production device (that is the printing head with bubble or ink jet), the coloured solutions must have a viscosity between 1 and 50 mPas and products must be added to prevent the formation of residue and the clogging of the printing systems, preferably non-foaming silicones.

When introducing a high number of pictures and variable factors in the pattern, it is opportune and preferable to apply identification elements on the individual printed products, preferably on the bottom, where they will be in contact with the glue.

According to this invention, it is possible to produce these identifying elements by means of bubble jet printing using the same solutions of soluble pigments indicated above, (preferably) allowing for a specific smooth area, without decorations, and sufficiently large to contain marking with bar codes, drawings, symbols and/or assembly diagrams.

To avoid the excessive lateral spreading of the colour and to remain within the graphic tolerances contemplated by bar code scanners, before printing it is necessary to apply, on the area where the code is to appear, a solution with a base of acrylic or vinyl dispersing mediums or dilutions in water of carboxymethyl cellulose or alginates or other mediums, preferably applied with a roller or spray.

The bubble or ink jet devices are fixed, they act on the surfaces to be decorated in movement and they may operate individually and/or in groups.

According to a preferred, but not exclusive, embodiment of the invention illustrated in the enclosed drawing sheet, a solution of salts of Co in glycol supplied by Metco Srl is loaded into a common tank 1 which feeds a group of Piezojet piezoelectric printing heads (2) supplied by the Xaar Company, placed alongside each other, carried on a fixed supporting rod transverse to the direction of advance of the conveyor belt 3 and having a total length equal to the width of the conveyor belt 3. The group of printing heads 2 is interfaced, in series or in parallel, with a logic unit 5 in which is installed processing pictures software of the type Corel Draw, which controls each of the bubble or ink jet systems 2 in producing the part of the pattern assigned to it.

The upper surface of the ceramic support 4 to be decorated, coming from the press 11, is wet before decoration with water or with an aqueous solution of impregnating agents by means of a special dosing device 6; on the bottom of the ceramic support, in the area intended for the identifying elements, an acrylic or vinyl dispersing medium or an aqueous solution of carboxymethyl cellulose or alginates is applied by means of a roller or a spray 7.

The activation of a sensor 8, generated by the advancing of the ceramic support 4 on the conveyor belt 3, determines the start of the printing phase managed by the logic unit 5, which controls the group of upper printing heads 2 for making the decoration and, at the same time, the bottom printing head 9 for making the bar

codes.

Once decorated, the top of the ceramic support 4 may be wet again with water or with impregnating solutions by means of the dosing device 10 before reaching the kiln 12 in which it will be fired at temperatures higher than 1000°C.

In the example of embodiment illustrated in the enclosed drawing sheet the colouring materials are applied on the supports 4 with a group of bubble or ink jet devices 2 placed alongside each other, carried on a fixed supporting rod (transverse to the direction of advance of the conveyor belt 3 and having a total length equal to the width of the conveyor belt 3) and fed by a common tank 1 containing a colouring material for applying on the supports 4; the logic unit 5 controls each of the bubble or ink jet devices 2 in producing the part of the pattern assigned to it.

Without departing from the scope of the invention, it is possible to feed in sequence the above-mentioned group of bubble or ink jet devices 2 by means of a plurality of common tanks 1, each of which contains one of the colouring materials to be applied on the supports 4, or to position in sequence (depending on the type of decoration to be produced) a plurality of groups of bubble or ink jet devices 2 and feed each group of devices by means of a common tank 1 containing one of the colouring materials to be applied on each support 4.

For the realisation of this invention, all the known electrically controlled devices may be used which deposit drops on the support 4 using different working principles: with continuous and non continuous mechanical, magnetic, electromechanical or thermal deflection, Bubble Jet and/or piezoelectric.

This invention also refers to an apparatus for performing the above-mentioned method, which comprises at least one bubble or ink jet device 2, of a commercial type, suitable for applying on the support 4 colouring materials having a high capacity for penetrating the support itself and a logic unit 5, which controls the bubble or ink jet devices 2 (preferably but not necessarily) in reply to configurations stored in at least one memory associated with the logic unit 5 or generated at the time of printing by the logic unit itself.

In the example of embodiment illustrated in the enclosed drawing sheet, in which the supports 4 are carried on a conveyor belt 3, the apparatus comprises at least:

- a group of bubble or ink jet devices 2, placed alongside each other, carried on a fixed supporting rod transverse to the direction of advance of the conveyor belt 3 and having a total length equal to the width of the conveyor belt 3;
- a common tank 1, containing a colouring material for applying on the supports 4, which feeds the bubble or ink jet devices 2 belonging to the above-mentioned group;
- the logic unit 5, which controls each of the bubble or ink jet devices 2 in producing the part of the pattern assigned to it.

Without departing from the scope of the invention, the apparatus may comprise a group of bubble or ink jet devices 2, placed alongside each other and fed in sequence by means of a plurality of common tanks 1, each of which contains one of the colouring materials to be applied on the supports 4, or a plurality of groups of bubble or ink jet devices 2 positioned in sequence (depending on the type of decoration to be produced), where each group of bubble or ink jet devices 2 is fed by means of a common tank 1 containing one of the colouring materials to be applied on each support 4.

The bubble or ink jet devices may be placed at any direction or distance from the support 4; each bubble or ink jet device and/or each or group of bubble or ink jet devices may be placed at any angle of inclination with respect to the support 4.

The apparatus may also comprise means for applying suitable products on the support surface 4 in order to limit the lateral spreading of the colouring materials in the material of which the support 4 is composed and further bubble or ink jet devices 9, controlled by the logic unit 5, for applying identifying elements on at least one non decorated area of the support 4, such as bar codes, drawings, symbols and/or assembly diagrams.

Without departing from the scope of the invention, it is possible for a skilled man to make any modifications and/or improvements suggested by normal experience and/or by the natural evolution of the technique to the decorating method and/or to the apparatus for performing the method.

CLAIMS

1. Method for decoration with one or more colours on an unfired ceramic support (flat, structured or not flat) made of stoneware, porcelainised stoneware or other equivalent material, with or without a covering of frit or enamel, characterised in that the decoration is achieved by applying on the support (4), by means of bubble or ink jet systems (2) controlled by a logic unit (5), colouring materials having a high capacity for penetrating the material of which the support (4) is composed.
2. Method as in claim 1, characterised in that the bubble or ink jet systems (2) are of a commercial type and are suitable for applying on the support (4) the colouring materials having a high capacity for penetrating the material of which the support (4) is composed.
3. Method as in claim 1 wherein the supports (4) are carried by a conveyor belt (3), characterised in that colouring materials are applied on the supports (4) by means of at least one group of bubble or ink jet systems (2) placed alongside each other, carried on a fixed supporting rod transverse to the direction of advance of the conveyor belt (3) and having a length equal to the width of the conveyor belt (3), fed by at least one common tank (1) containing a colouring material to be applied on the supports (4) and in that the logic unit (5) controls each of the bubble or ink jet systems (2) in producing the part of the pattern assigned to it.
4. Method as in claim 3, characterised by comprising a group of bubble or ink jet systems (2) placed alongside each other, fed in sequence by plurality of common tanks (1), each of which contains one of the colouring materials to be applied on the supports (4).
5. Method as in claim 3, characterised by comprising a plurality of groups of bubble or ink jet systems (2) placed alongside each other; said groups being positioned in sequence, each group being fed by a common tank (1) containing one of the colouring materials to be applied on each support (4).
6. Method as in claim 1 or 3, characterised in that the bubble or ink jet systems (2) may be placed at any direction or distance from the support (4), each bubble or ink jet system (2) or group of bubble or ink jet systems (2) may be placed at any angle of inclination with respect to the support (4).
7. Method as in claim 1, characterised in that the colouring materials are soluble

pigments specifically intended for the material used to make the support (4) having a high capacity for penetrating the material of which the support (4) is composed.

8. Method as in claim 7, characterised in that the pigments are soluble in water-alcohol mediums, water, glycol, and solutions that do not conduct electricity, in that said soluble pigments include complexed salts or metal chromophore ions with polycarboxyl organic acids or organic or inorganic derivatives and in that the soluble pigments and/or their mixtures are fired at a temperature of over 1000 °C after they have been applied on the ceramic unfired support.

9. Method as in claim 1, characterised in that the logic unit (5) controls the bubble or ink jet systems (2) in reply to configurations stored in at least one memory associated with the logic unit (5) or generated at the time of printing by the logic unit itself.

10. Method as in claim 1, characterised by limiting the lateral spreading of the colouring materials in the material of which the support (4) is composed by applying on the surface of the support (4), by means of a spray or rollers, vinyl or acrylic dispersing mediums and/or solutions of carboxymethyl cellulose or alginates.

11. Method as in claim 1, characterised by comprising also the step of applying identification elements on at least one non decorated part of the support (4), by means of further bubble or ink jet systems (9) controlled by the logic unit (5).

12. Method as in claim 11, characterised in that the identification elements are composed of bar codes, drawings, symbols and/or assembly diagrams.

13. Apparatus for performing the method as in at least one of the previous claims, characterised by comprising at least one bubble or ink jet system (2) for applying on the support (4) colouring materials having a high capacity for penetrating the material of which the support is composed and a logic unit (5), which controls the bubble or ink jet systems (2).

14. Apparatus as in claim 13, characterised in that the bubble or ink jet systems (2) are of a commercial type.

15. Apparatus as in claim 13 wherein the supports (4) are carried on a conveyor belt (3), characterised by comprising:

- at least one group of bubble or ink jet systems (2) placed alongside each other,

carried on a fixed supporting rod transverse to the direction of advance of the conveyor belt (3) and having a length equal to the width of the conveyor belt (3);

- at least one common tank (1), containing a colouring material for applying on the supports (4), which feeds the bubble or ink jet systems (2) belonging to at least one group of bubble or ink jet systems (2); and
- the logic unit (5), which controls each of the bubble or ink jet systems (2) in producing the part of the pattern assigned to it.

16. Apparatus as in claim 15, characterised by comprising:

- at least one group of bubble or ink jet systems (2) placed alongside each other, carried on a fixed supporting rod transverse to the direction of advance of the conveyor belt (3) and having a length equal to the width of the conveyor belt (3); and
- a plurality of common tanks (1), each of which contains one of the colouring materials to be applied on the supports (4), which feed in sequence the bubble or ink jet systems (2) belonging to the group of bubble or ink jet systems (2).

17. Apparatus as in claim 15, characterised by comprising:

- a plurality of groups of bubble or ink jet systems (2) placed alongside each other, each group being carried on a fixed supporting rod transverse to the direction of advance of the conveyor belt (3) and having a length equal to the width of the conveyor belt (3); and
- a plurality of common tanks (1), each of which contains one of the colouring materials to be applied on the supports (4), each common tank (1) feeding one of the groups of bubble or ink jet systems (2).

18. Apparatus as in claims 13 to 17, characterised in that the bubble or ink jet systems (2) may be placed at any direction or distance from the support (4), each bubble or ink jet system (2) or group of bubble or ink jet systems (2) being able to be tilted with respect to the support (4).

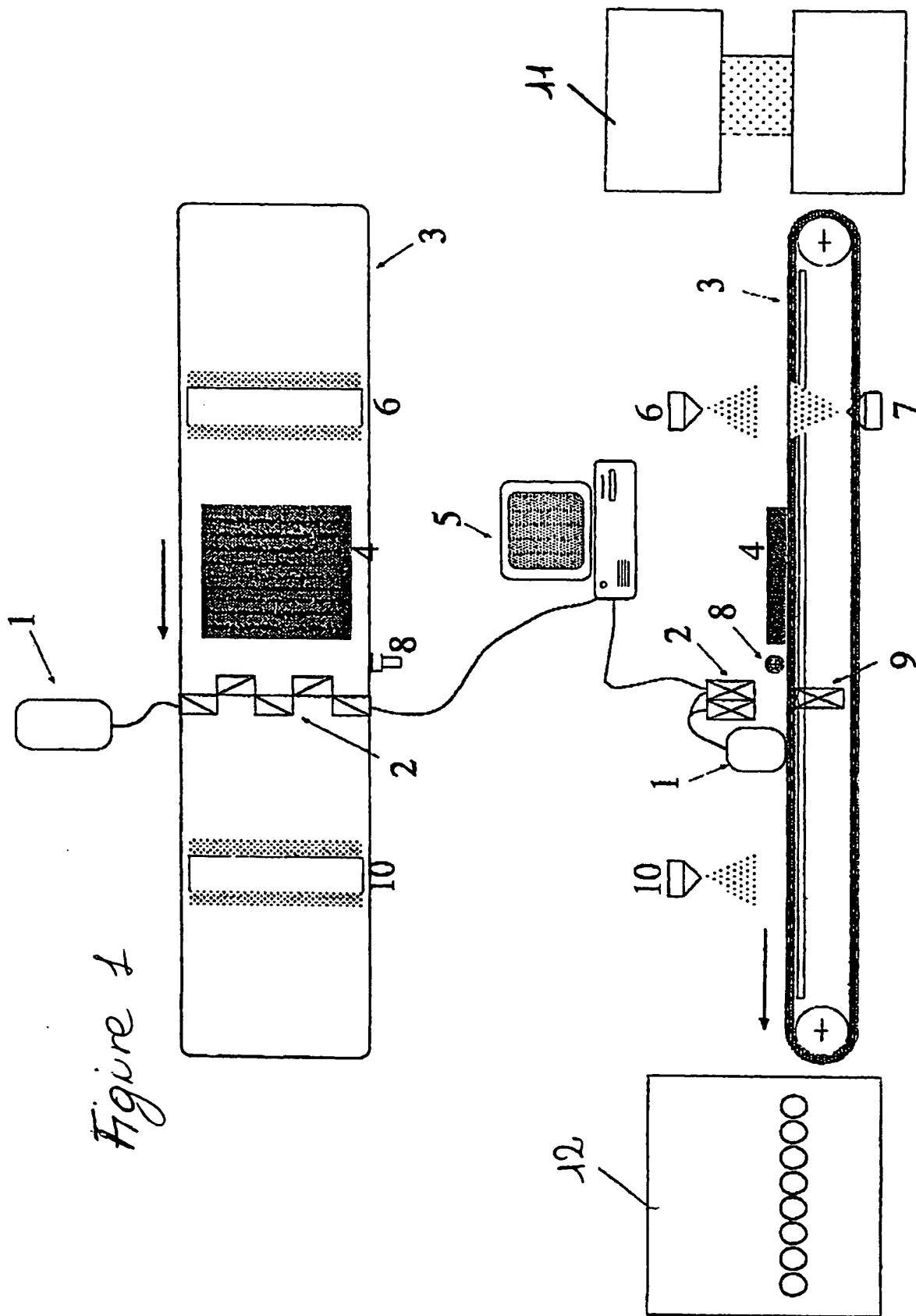
19. Apparatus as in claim 13, characterised in that the logic unit (5) controls the bubble or ink jet systems (2) in reply to configurations stored in at least one memory associated with the logic unit (5) or generated at the time of printing by the logic unit itself.

20. Apparatus as in claim 13, characterised by further comprising means for

applying suitable products on the support surface (4) in order to limit the lateral spreading of the colouring materials in the material of which the support (4) is composed.

21 Apparatus as in claim 13, characterised by including further bubble or ink jet systems (9), controlled by the logic unit (5), for applying identifying elements on at least one non decorated area of the support (4).

22. Apparatus as in claim 21, characterised in that the identifying elements are composed of bar codes, drawings, symbols and/or assembly diagrams.



INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 00/03483

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C04B41/81 B41M1/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C04B B41M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, CHEM ABS Data, EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE WPI Section Ch, Week 199935 Derwent Publications Ltd., London, GB; Class L02, AN 1998-566173 XP002148120 & ES 2 131 466 A (COLOROBIA ESPANA SA), 16 July 1999 (1999-07-16) abstract	1,2,13, 14,19
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

22 September 2000

Date of mailing of the international search report

04/10/2000

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INTERNATIONAL SEARCH REPORT

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